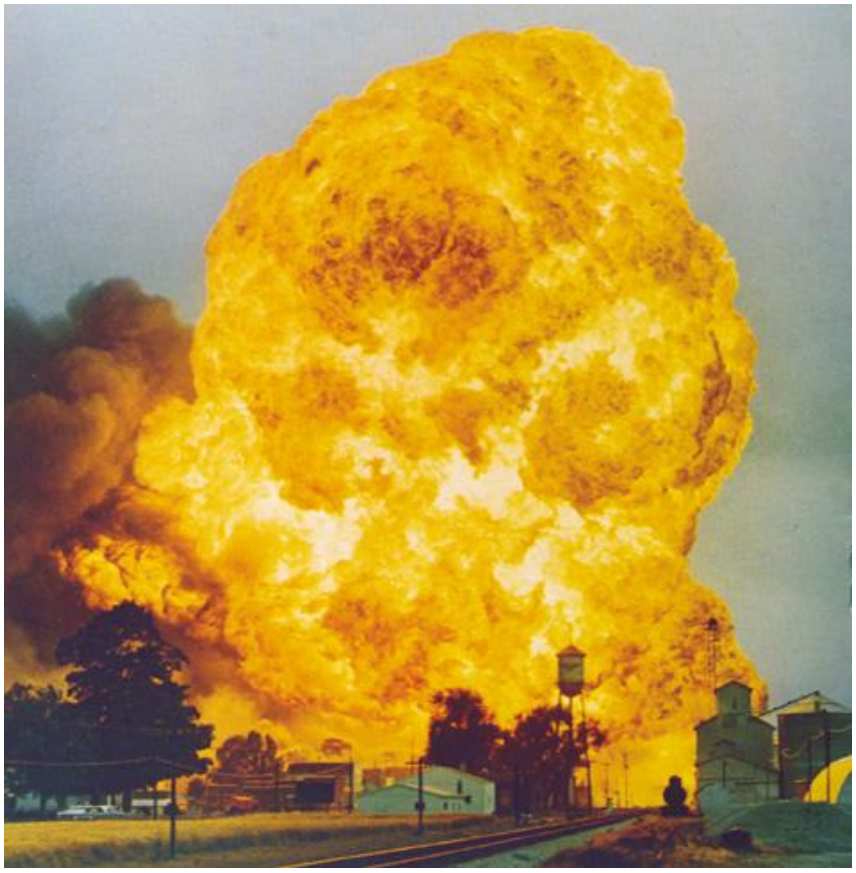
Emergency and Disaster Response to Chemical Releases

Technician Level Training

29 CFR 1910.120(q)



Module 6

Safety

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Table of Contents

Acronyms Used in This Module

AIDS	Acquired Immunodeficiency Syndrome
HBV	Hepatitis B Virus
HCV	Hepatitis C Virus
HIV	Human Immunodeficiency Virus
OSHA	Occupational Safety and Health Administration
PPE	Personal Protective Equipment

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Overview

Chemical release response safety cannot be covered by a set of rules for all situations. That is why hazard/risk analysis is so important in the decision-making process from the safety aspect in dealing with emergency situations. All aspects of worker safety must be considered by responders in order to maintain a safe response. OSHA regulations help to ensure that site operations do not threaten responders, the surrounding community, or the environment. This module will address safe work practices in respect to health-related issues associated to response and disaster sites. Use of risk analysis, sound judgment, and safe practices are essential for responder safety.

Terminal Learning Objective

Upon completion of this module the participants will, based upon hazard/risk analysis, determine if response to a condition or situation is within acceptable safety parameters.

Enabling Objectives

Based on information presented in the classroom, the participant will be able to:

- Explain the difference between hazard and risk.
- Describe the basic concepts of safety as they relate to "acceptability of risk."
- Identify safety hazards that may be present at a response/disaster scene.
- List three lines of defense used to manage risk when responding to chemical releases.
- List the components of risk analysis.

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Introduction

Emergency and disaster response to chemical release safety cannot be covered by a set of safety rules for all conceivable situations that could lead to an unsafe condition. No one can anticipate all conceivable situations and, even if they could, most releases result from a combination of errors, accidents or events. The possible combinations make the number of conceivable situations astronomical.

At chemical releases, Murphy's Law prevails. Releases of chemicals happen at the most inopportune time, at the worst possible place, and if more then one thing can go wrong, the worst possible thing will go wrong. Many times the full extent of the problem is not discovered until cleanup operations are underway. When doing hazardous chemical spill cleanup, always be prepared for the worst. If you plan for the worst, you can protect yourself from the worst.

Planning and preparation does not mean reacting to every release of hazardous material as if it were the end of the world. The key to a safe response is using safety procedures based on the hazards present and the risks of each hazard. Overreaction can be as risky as underestimating the hazard and risk.

A common definition of safety is "freedom from danger or harm." In reality nothing is completely safe. It just is not possible for something to be completely free from danger or harm. We can always make something safer. For spill and disaster response, safety must be based on an understanding of hazard and risk.

Hazard

Hazard is defined as any substance, situation, or condition that is capable of harming human health, property, or the environment. A hazard is a potential for harm. A hazard can cause serious harm or only slight harm or irritation. Hazards such as those from hazardous chemicals are capable of causing harm, but the term hazard does not measure how serious a

potential harm might be or how likely it is to occur. With proper precautions the potential for a hazard to do harm is greatly reduced.

Risk

Risk is defined as "a measure of the probability and severity of a hazard to harm human health, property or the environment." Risk is a measure of how likely harm is to occur and an indication of how serious the harm will be if it does occur. The severity of a direct hit on you by a meteorite is quite great, downright fatal, but the probability of a meteorite hitting you is very low, thus the risk is very low. The severity of a common cold to the average person is quite low; the probability of catching one is quite high. The risk of harm from a common cold is quite low.

Risk is very difficult to evaluate, but we all have our own feelings about how risky the presence of certain hazards might be. Different people will evaluate the risk of a particular hazard differently. This must be accepted and anticipated. When evaluating the risk involving a spill cleanup, all members of the clean-up team should share their evaluation of the risk. It is essential that risks from all hazards present is evaluated and that the person in charge of the clean up selects a safe mode of operation.

Safety

Safety may be defined as "a judgment of the acceptability of risk." That is, once we have estimated how risky something is, we judge for ourselves whether we consider it safe and, therefore, whether we will voluntarily accept the risk and complete the task at hand. If the risk is high we will call it unsafe and seek an alternative to the task. If the risk is low, we call it safe and go ahead and complete the task.

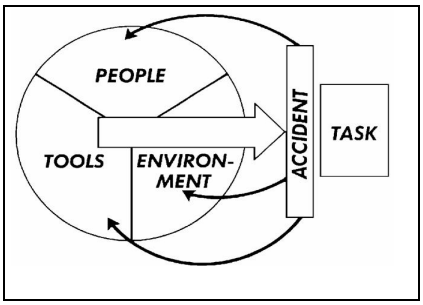
Sometimes people are unwilling to accept a situation or task because they mistakenly think it is more risky than it actually is. Other times, some individuals may be willing to accept a situation or task because they mistakenly think it is less risky than it actually is.

In spill response, we must evaluate all hazards present. It is very easy to overprotect ourselves. In using too much protection we may, in fact, increase our risk due to the protective equipment we have chosen.

Spill response teams must evaluate risk from each task required in a cleanup operation. If the risk is moderate or high, alternatives with lower risks must be found. Risk management is the key to safe spill and disaster response operations.

Risk Management

Since the magnitude of risk involves both the probability and severity of the associated hazard, risk management can be based on reducing the severity, the probability, or both. A response team should manage risk based on "three lines of defense."



1. Prevent the accidental release of a hazardous substance.
2. Prevent exposure, if release does occur.
3. Prevent injury, if exposure does occur.

These three lines of defense are established by:

- Engineering controls.
- Following safe work practices.
- Training.

Vulnerability Assessment and Risk Analysis

Vulnerability assessment identifies and measures the weaknesses within a system. Risk analysis is the process of formally identifying the assets incorporated in or associated with a response and calculates the relative degree of risk for the assets impacted by an event. Threat analysis calculates and measures the threats that may affect response assets and response vulnerabilities in order to assess the level of damage expected should a disaster or terrorist event occur.

Vulnerabilities

Vulnerabilities are the one element of risk over which you have control. Vulnerabilities are built into response teams through the equipment they use, the procedures they follow, and the policies they make. Vulnerabilities are independent of the threat but are always there to be exploited.

Components of Risk Analysis

There are five principal components to be considered in risk analysis:

1. Assets - An asset is any item that may require protection and may be tangible (premises, equipment) or intangible (information, goodwill).
2. Vulnerability - Vulnerability is an inherent weakness of an asset that may be exploited in an event.
3. Safeguards - Safeguards are those system components and procedures that reduce vulnerabilities.
4. Threats - A threat is an event or a group of like events that may damage one or more assets.
5. Impact - Impact is an assessment of the level of damage that would be caused by a threat event (accident or attack) occurring.

Risk

The relationship between the components of risk is shown in Figure 1, on the next page, which is based on the model of risk initially developed by Robin Moses of BIS Applied Systems.

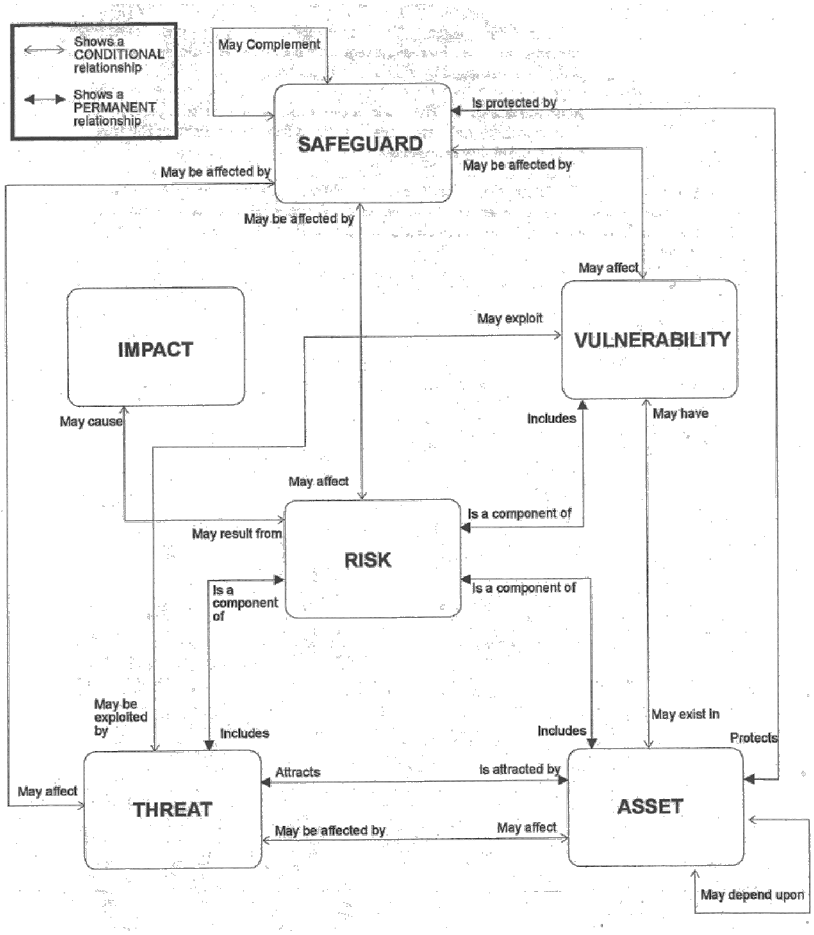


Figure 1: Components of Risk ('Moses' Model)

Calculating Risk

Calculating risk requires that you put together all of your threat, asset value, and vulnerability information. Risk is the product of the likelihood an event will occur, the value of the loss of an asset, and the vulnerability of the security measures protecting that asset.

Being able to show risk results quantitatively allows you to compare all your results on a common basis.

Risk = Threat likelihood x Value of loss x Vulnerability

Threat Characterization	Asset Identification	Vulnerability Assessment

Countermeasures and Risk Reduction

The goal of all risk assessments is to provide the information that will allow response command to make judgments about how to manage those risks. It is not possible to eliminate all risks. You may be willing to accept a certain risk because the operational impact will be small.

Implementing countermeasures will reduce risk. However, there is a cost to implementing each countermeasure. A good goal is to find a set of countermeasures that provide the greatest risk reduction for the lowest cost. Comparing the cost of each countermeasure to the change in risk it produces allows you to rank proposed countermeasures by their cost effectiveness.

Risk is the standard that can be used to make decisions about allocating the resources that you devote to response. The questions you need to ask are:

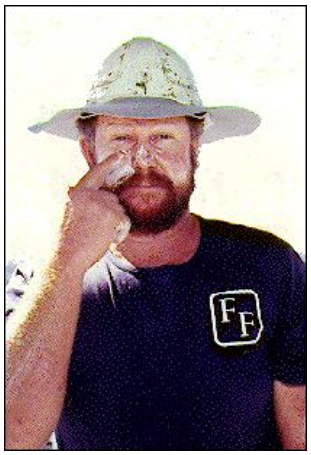
1) Does the countermeasure reduce my risk?
2) If so, by how much?
3) Is the amount that I can reduce my risk by implementing the countermeasure worth the cost of implementing it?

Managing Risks

Managing risks involves the previously mentioned measures for identification, the clear definition of problem areas, and selecting and implementing proper countermeasures that will offset the identified risks. Just as the opportunity to commit an act that results in a loss is site-specific, methods of management are unique to every site and must be tailored individually to the needs of the community and incident. The methods selected must be practical, workable in a human context, and consistent with the command's stated goals.

Responder Health Risk Factors

Heat Stress



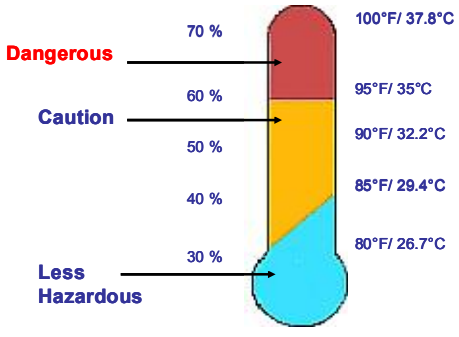
Responders wearing protective clothing can face a risk from heat stress. Additionally, heat stress may be an important concern when working in a hot environment or within containment structures. Heat stress is caused by a number of interacting factors, including environmental conditions, type of protective clothing worn, the work activity required, and the individual characteristics of the employee. In situations where heat stress is a concern, employers should use appropriate work/rest regimens and provide heat stress monitoring that includes measuring employee heart rates, body temperatures, and weight loss.

A source of water or electrolytic drink should be close to the work area (in a non-contaminated eating/drinking area) so that it will be used often. Responders should wash their hands and face prior to drinking any fluid. Frequent fluid intake throughout the day will replace body fluids lost to evaporation. If such measures are used to control heat stress, protective clothing can be safely worn to provide the needed protection against lead exposure. The possibility of heat stress and its signs and symptoms should be discussed with all responders.

When the body is unable to cool itself through sweating, serious heat illnesses may occur. The most severe heat-induced illnesses are heat exhaustion and heat stroke. If actions are not taken to treat heat exhaustion, the illness could progress to heat stroke and possible death.

Heat Exhaustion

Your Body's Response



- Headaches, dizziness/light headedness, weakness
- Mood changes (irritable, or confused/can't think straight)
- Feeling sick to your stomach, vomiting/throwing up
- Decreased and dark-colored urine, fainting/passing out, and pale clammy skin

What Should Be Done

- Move the person to a cool, shaded area to rest. Don't leave the person alone. If the person is dizzy or light-headed, lay them on their back and raise their legs about 6 to 8 inches. If the person is sick to their stomach, lay them on their side.
- Loosen and remove any heavy clothing.
- Have the person drink some cool water (a small cup every 15 minutes) if they are not feeling sick to their stomach.
- Try to cool the person by fanning them. Cool the skin with a cool spray mist of water or wet cloth.
- If the person does not feel better in a few minutes, call for emergency help (ambulance or call 911). (If heat exhaustion is not treated, the illness may advance to heat stroke.)

Heat Stroke: A Medical Emergency

What Happens to the Body

- Dry pale skin (no sweating)
- Hot, red skin (looks like a sunburn)
- Mood changes (irritable, confused/not making any sense)
- Seizures/fits
- Collapses/passed out (will not respond)

What Should Be Done

- Call for emergency help (ambulance or call 911).
- Move the person to a cool, shaded area. Don't leave the person alone. Lay them on their back and if the person is having seizures/fits, remove any objects close to them so they won't strike against them. If the person is sick to their stomach, lay them on their side.
- Remove any heavy and outer clothing.
- Have the person drink some cool water (a small cup every 15 minutes) if they are alert enough to drink anything and not feeling sick to their stomach.
- Try to cool the person by fanning them. Cool the skin with a cool spray mist of water, wet cloth, or wet sheet.
- If ice is available, place ice packs under the arm pits and groin area.

How to Protect Responders

- Learn the signs and symptoms of heat-induced illnesses and what to do to help the responder.
- Train the workforce about heat-induced illnesses.

- Perform the heaviest work in the coolest part of the day.
- Slowly build up tolerance to the heat and the work activity (usually takes up to 2 weeks).
- Use the buddy system (work in pairs).
- Drink plenty of cool water (one small cup every 15 to 20 minutes)
- Wear light, loose-fitting, breathable (like cotton) clothing.
- Take frequent short breaks in cool, shaded areas (allow your body to cool down).
- Avoid eating large meals before working in hot environments.
- Avoid caffeine and alcoholic beverages (these beverages make the body lose water and increase the risk for heat illnesses).

Responders Are at Increased Risk When

- They take certain medication(s) (check with your doctor, nurse, or pharmacy and ask if any medicines you are taking will affect you when working in hot environments).
- They have had a heat-induced illness in the past.
- They wear personal protective equipment (like respirators or suits).

Cold Stress

When the body is unable to warm itself, serious cold-related illnesses and injuries may occur, and permanent tissue damage and death may result. Cold-related illnesses can slowly overcome a person who has been chilled by low temperatures, brisk winds, or wet clothing. Hypothermia can occur when land temperatures are above freezing or when water temperatures are below 98.6°F/37°C.

Your Body's Response

- Freezing occurs in deep layers of skin and tissue; results in pale, waxy-white skin color.
- Skin becomes hard and numb; usually affects fingers, hands, toes, feet, ears, and nose first.

What Should Be Done (Land Temperatures)

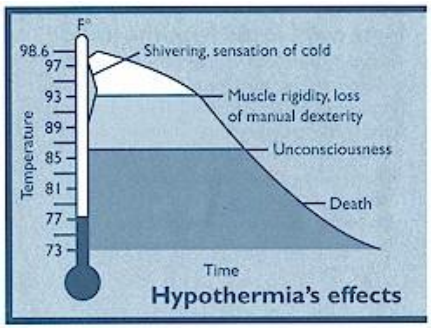
- Move the person to a warm, dry area. Don't leave the person alone.

- Remove any wet or tight clothing that may cut off blood flow to the affected area.
- Do not rub the affected area because rubbing causes damage to the skin and tissue.
- Gently place the affected area in a warm (105°F) water bath and monitor the water temperature to slowly warm the tissue. Don't pour warm water directly on the affected area because it will warm the tissue too fast causing tissue damage. Warming takes about 25 to 40 minutes.
- After the affected area has been warmed, it may become puffy and blister.
- The affected area may have a burning feeling or numbness. When normal feeling, movement, and skin color have returned, the affected area should be dried and wrapped to keep it warm. NOTE: If there is a chance the affected area may get cold again, do not warm the skin. If the skin is warmed and then becomes cold again, it will cause severe tissue damage.
- Seek medical attention as soon as possible.

Hypothermia - Medical Emergency

Your Body's Response

- Normal body temperature (98.6°F/37°C) drops to or below 95°F (35°C); fatigue or drowsiness; uncontrolled shivering; cool, bluish skin
- Slurred speech; clumsy movements; irritable, irrational
- Confused behavior



What Should Be Done (Land Temperatures)

- Call for emergency help (ambulance or call 911).
- Move the person to a warm, dry area. Don't leave the person alone. Remove any wet clothing and replace with warm, dry clothing or wrap the person in blankets.
- Have the person drink warm, sweet drinks (sugar water or sports-type drinks) if they are alert. Avoid drinks with caffeine (coffee, tea, or hot chocolate) or alcohol.
- Have the person move their arms and legs to create muscle heat. If they are unable to do this, place warm bottles or hot packs in the arm pits, groin, neck, and head areas. Do not rub the person's body or place them in a warm water bath. This may stop their heart.

What Should Be Done (Water Temperatures)

- Call for emergency help (ambulance or call 911). Body heat is lost up to 25 times faster in water.
- Do not remove any clothing. Button, buckle, zip, and tighten any collars, cuffs, shoes, and hoods because the layer of trapped water closest to the body provides a layer of insulation that slows the loss of heat. Keep the head out of the water and put on a hat or hood.
- Get out of the water as quickly as possible or climb on anything floating. Do not attempt to swim unless a floating object or another person can be reached because swimming or other physical activity uses the body's heat and reduces survival time by about 50 percent.
- If getting out of the water is not possible, wait quietly and conserve body heat by folding arms across the chest, keeping thighs together, bending knees, and crossing ankles. If another person is in the water, huddle together with chests held closely.

How to Protect Responders

- Recognize the environmental and workplace conditions that lead to potential cold-induced illnesses and injuries.
- Learn the signs and symptoms of cold-induced illnesses/injuries and what to do to help the responder.
- Train the workforce about cold-induced illnesses and injuries.
- Select proper clothing for cold, wet, and windy conditions. Layer clothing to adjust to changing environmental temperatures. Wear a hat and gloves, in addition to underwear, that will keep water away from the skin (polypropylene).
- Take frequent short breaks in warm, dry shelters to allow the body to warm up.
- Perform work during the warmest part of the day.
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm.
- Use the buddy system (work in pairs).
- Drink warm, sweet beverages (sugar water, sports-type drinks). Avoid drinks with caffeine (coffee, tea, or hot chocolate) or alcohol.
- Eat warm, high-calorie foods like hot pasta dishes.

Responders Are at Increased Risk When

- They have predisposing health conditions such as cardiovascular disease, diabetes, and hypertension.

- They take certain medication (check with your doctor, nurse, or pharmacy and ask if any medicines you are taking affect you while working in cold environments).
- They are in poor physical condition, have a poor diet, or are older.

Fatigue

Fatigue is a message to the body to rest. It is not a problem if the person can and does rest. However, if rest is not possible, fatigue can increase until it becomes distressing and eventually overwhelming.

The symptoms of fatigue vary and do depend on the person and their degree of fatigue or sleep deprivation; some examples include:

- Weariness.
- Sleepiness.
- Irritability.
- Reduced alertness, concentration, and memory.
- Lack of motivation.
- Increased susceptibility to illness.
- Depression.
- Headache.
- Giddiness.
- Loss of appetite and digestive problems.

Many conditions can lead to fatigue. For example, fatigue resulting from long hours of work and a shorter length of time between work shifts is an important concern for the health and safety of responders on extended workdays. Responders may be too tired by the end of 10 or 12 hours and jeopardize their own well-being as well as the safety of others on the job.

Bloodborne Pathogens

There once was a time when you could come to the rescue of a person without much thought given to your own safety. Unfortunately, today that is no longer the case due to bloodborne pathogens. When most people think of bloodborne pathogens, or diseases transmitted through contact with blood or other body fluids, HIV (human immunodeficiency virus) and AIDS (acquired

immunodeficiency syndrome) are the diseases that most readily come to mind. However, there are other diseases that can be just as deadly. These are HBV and HCV or hepatitis B and C viruses.

BBP Safety Rules

- Follow universal precautions.
- Use the required personal protective equipment.
- Wash exposed areas with antibacterial soap.
- Treat all human body fluids and items soiled with human body fluids as contaminated.
- No smoking, eating, drinking, or storage of food.
- Pre-soak all contaminated clothing.
- Disinfect all spills of body fluid.
- Report any suspected exposure to your supervisor.
- Place all medical wastes in a red, leak-proof container marked either Biohazard or Medical Waste.

Stress

Stress has become an inevitable part of daily life in the United States for the majority of Americans. Add the stressors of a disaster event and the human body will react to the stress with a "fight or flight" response. The body has a surge of adrenaline that prepares the body for a physically challenging event. This physiological response was intended to be infrequent. Unfortunately, many people today interpret their environment as hostile the majority of the time. This causes numerous physiological changes to occur in the body. The blood pressure increases, the pulse rate increases, and over a long period of time, the immune system begins to falter. This would explain why individuals who are under a lot of stress become ill more frequently than usual. Stress can also play a part in the development of heart disease. The high adrenaline state accelerates the development of heart disease. The blood tends to clot more rapidly. This would explain why individuals subjected to an acute stressful event can have a heart attack. They almost always have underlying heart disease.

Physiological Symptoms of Stress

- Muscle tension in the jaw and forehead
- Digestive changes, such as constipation or diarrhea
- Dry throat
- Fatigue
- High blood pressure
- Grinding of the teeth
- Headaches
- Indigestion
- Muscle aches
- Pounding of the heart
- Shortness of breath
- Upset stomach

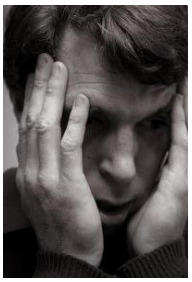
Psychological Symptoms of Stress

Stressful situations, whether long-term or short-term, can set forth a series of emotional symptoms such as a feeling of personality disintegration, phobia, anxiety attacks, unfocussed attention or distractions, exaggerated emotional responses, and psychological discomposure such as depression, confusion, burn-out, and vehicular accidents.

- Anger
- Anxiety
- Apathy
- Cynicism
- Defensiveness
- Depression
- Difficulty concentrating
- Feelings of helplessness, hopelessness or worthlessness
- Feelings of being misunderstood or unappreciated
- Hypersensitivity
- Insecurity
- Irritability
- Lack of direction
- Pessimism
- Resentment
- Sadness
- Insomnia
- Isolation or withdrawal from others
- Lessened enjoyment of activities that were once pleasurable
- Loss of appetite or, in contrast, overeating
- Loss of sexual desire

- Procrastination
- Readiness to argue

Behavioral Symptoms of Stress



- Increased smoking
- Increased use of alcohol or drugs
- Nail biting
- Neglect of responsibility
- Poor job performance
- Unusually poor hygiene

Physical Risk Factors for Responders

Structure Collapse

Structural collapse operations at disaster sites pose unique and changing safety challenges. Whether the events encountered are single story structures with easily accessible victims or multi-story buildings with hundreds of victims, responders at all stages of operation must be familiar with the safety hazards that they face. Effective operations at a structural collapse can only be possible if responders are fully aware of the hazards involved and the methods necessary to mitigate those hazards.

Safety in such an event is most importantly an attitude. It becomes a balance between accomplishing the task assigned in the shortest possible time and minimizing the risk associated with the task. It requires specialized training.

In order for responders and skilled support personnel working at a structural collapse to perform operational tasks at an optimum level of safety, they must be familiar with:

- The types of risk and hazards to which they will be exposed.
- Building construction types and characteristics.
- The manner of building collapse.
- Indicators of compromised structure integrity.
- Types of voids and areas of survivability.
- Personal protective safety equipment.
- Safety hazards that may be present at disaster sites that involve CBRNE agents.
- Safe zones and escape routes.

Understanding and properly applying these factors is essential for responders to operate safely in structural collapse areas.

Structure Collapse Risk Hazards

Responders or skilled support personnel working in the area of structural collapse are exposed to many risks. Structures that are only partially collapsed are probably the most dangerous to operate in or around. These typically large and heavy buildings are difficult to shore and are prone to sudden, catastrophic failures, giving those in the area little warning to evacuate. Many of these risks are common and can be associated with demolition work. These hazards include but not limited to:

- Secondary collapse.
- Unfamiliar surroundings.
- Unstable structures.
- Hazards of demolition.
- Falling material or flying objects.
- Exposure to smoke, dust, etc.
- Fire and explosion.
- Excessive noise.
- Electrical hazards.
- Confined space operations.
- Oxygen deficient atmospheres.
- Dangerous (heavy) equipment.
- Noise and vibration.
- Excessive fatigue, sleep stress.
- Personal hygiene.
- Hydration.

This is only a partial list of the hazards that can be associated with structural collapse. In this course we will primarily key in on:

- Secondary collapse.
- Unstable structures.

Performing Work While at Risk

Some of the most dangerous work you may encounter is work performed in a collapsed or unstable structure. You may be exposed to hazards for which you may have little or no training, and a lack of experience will make it impossible to recognize all of the safety hazards, or to know what actions to take to eliminate the hazards.

Injuries to responders, in many cases, are the result of inexperience or reckless actions. Clearly defined means and methods of operation and a skilled and experienced workforce are vital to the safety of those

working in or near the structure. It is important for you to know that the safe completion of the project is a balance between accomplishing the many hazardous tasks in the shortest possible amount of time and taking the necessary time to minimize the amount of risk that you are exposed to.

Never undertake a task in an unstable or collapsed structure unless you have experience working around unstable structures have and the specialized training necessary to complete the task. If you are called upon to assist in this situation and you lack the necessary experience, tell someone. Your safety is the most important issue when dealing with an unstable structure.

Building Instability and Other Hazards

As a responder, you must understand the importance of recognizing safety hazards. You must be prepared to address safety practices and the importance of incorporating safety into your job activities. You should be able to perform hazard/risk analysis for a specific task and know what actions to take to minimize risks and/or eliminate the hazards. Responders must take extra precautions to minimize injuries by wearing the required personal protection equipment (PPE) when working in the affected area.

Electrical Hazards

Responders have to be especially aware of electrical hazards from damaged utilities. There are many electrical-related fatalities associated with disaster response operations. Some of the electrical hazards that are commonly found during clean-up operations are:

- Downed power lines.
- Energized power grids.
- Damaged connection boxes.
- Displaced power transformers and controls.

Hazardous Material Exposure

Another significant risk to responders on a structural collapse is exposure to hazardous material. There are two kinds of exposure to consider:

- Direct exposure from an area that is contaminated during a collapse.
- Indirect exposure from moving water or a cloud/vapor plume moving through or beyond the collapse area.

Facilities such as hospitals, labs, universities, manufacturing plants, and warehouses have a broad array of hazardous material on site. If you are unable to recognize these hazards, your safety and the safety of those working around you will be in jeopardy.

Indicators of Collapsed Structure Integrity

- Walls out of plumb
- Walls that have large bows in the middle are leaning or separated from the floor
- Beams pulling away
- Separation of support or load bearing beams from the structure
- Buckled steel beams
- Beams that sag or are distorted, particularly after heavy fire loads
- Large cracks, plaster falling
- Large cracks that appear in walls, roofs, floors, or other structural components
- Accumulated water – Water weighs 8.34 pounds per gallon. Addition of water to a structure could accelerate collapse conditions.
- Noise - Buildings that creak, moan, groan, snap, crackle, or pop

Types of Collapse

Structures collapse in predictable patterns with predictable secondary collapse dangers.

V-Shaped

Secondary Collapse Danger: Bearing wall failure due to lateral load placed on bearing walls by broken floors. Floors may collapse further.

Victims' Found: In voids near wall or at the center of the "V."

Cause of Collapse: A center floor overload.

Pancake

Secondary Collapse Danger: Collapse of the lean-to flooring and/or a bearing wall collapse due to lateral load placed against the bearing wall by the lean-to floor.

Victims' Found: Between floors in voids created by large pieces of furniture.

Cause of Collapse: Shock impact of heavy falling weight.

Lean-to

Secondary Collapse Danger: Collapse of lean-to flooring and/or a bearing wall collapse due to lateral load placed against the bearing wall by the lean-to floor.

Victims' Found: Beneath the lean-to, near the wall.

Cause of Collapse: An end floor overload.

Cantilever

Secondary Collapse Danger: Least stable of all patterns and most vulnerable to secondary collapse. Collapse of floor with limited support.

Victims' Found: Under the supported ends of floors.

Cause of Collapse: When one of the sidewalls of a multistory building collapses leaving the floors attached to and supported by the remaining sidewall.

Debris Removal

Debris removal from a collapsed or unstable building can be every bit as dangerous as the actual demolition itself. On a standard demolition project, debris is generated by separating the connections and attachments of various materials from a stable structure, at a controlled pace, segregating the material, and staging it to facilitate safe and convenient removal. Care is taken to place debris in clear, stable areas so that the removal of the debris does not impact the stability of the structure, or the safety of the responders.

In a collapsed or unstable structure, the removal of any debris can be extremely hazardous. Intentionally moving or shifting debris can significantly affect the stability of the structure. Many of the connections and attach points between materials remain intact and are concealed from view. Pulling on a piece of debris, either by hand or with a machine, can cause movement in a debris pile many feet from the removal operation. This movement can expose responders away from the immediate area to unexpected struck by, caught between, and fall hazards. Removing debris from a pile shifts the weight and balance of the unstable structure. This shift can cause the structure to unexpectedly collapse further and endanger responders.

Debris piles can contain hazardous material that, if not recognized immediately, can endanger not only responders but transportation personnel, landfill personnel, and the general public miles from the disaster site.

The disposal of debris on a collapse site needs to be treated with the same care and consideration as the demolition of the structure itself. Responders without the experience and training to manage the

demolition of a structure should never be used to simply remove the debris. To the extent possible, debris removal plans should be made prior to the start of any work, and responders not essential to the disposal operation should be removed from the area.

There are conditions that might be found on a disaster site that would be different from those a responder might expect to find when doing his job on a normal jobsite, these differences include:

- Unstable, partially collapsed, or totally collapsed structures.
- A different, extended, or unusual chain of command.
- An extended pre-job or pre-task orientation period.
- Unexpected, unknown, undocumented hazardous material.
- Higher than normal PPE requirements.
- Blocked or unsafe access to work areas.
- Unexpected/unknown holes or voids.
- Debris created non-standard confined spaces.
- Much more frequent occurrences/conditions that create slip, trip, and fall hazards.

- Higher levels of decontamination generally required.
- Environmental/weather considerations not normally present.
- Special considerations necessary for biological needs (sanitation, eating, drinking, etc.).
- Higher than normal levels of stress and psychological pressures.
- Higher levels of urgency (leading to inadvertent/unnoticed lessening of safety/PPE considerations).
- The need for emergency or contingency plans for rescue of responders injured or trapped while working post-disaster.

Summary

After identifying risk factors, loss probability, and criticality of loss, appropriate countermeasures can be taken. Methods for risk management are tailored for specific sites and situations.

There are three primary reasons for losses:

1. Opportunity was not recognized.
2. Countermeasures were insufficient, improperly designed or implemented, or not effective.
3. The level of vulnerability of a community, organization, or business changed.

All aspects of responder safety must be considered by responders in order to maintain a safe response. Many safe work practice concerns are involved when working on a disaster site. Responders need to know how to control the response environment to minimize the dangers involved.

Review Questions

1. Explain the difference between hazard and risk.

2. How is safety determined?

3. What are the three lines of defense used to manage risk from spills?

4. Describe the use of Universal Precautions as it relates to bloodborne diseases.

5. How are bloodborne diseases transmitted?

6. Which of the two major bloodborne pathogens discussed are of the greatest threat to the responder?

   Why?

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